Towards Agent-Based Simulation of Maritime Customs (Extended Abstract)

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ABSTRACT

The operation of a port, including its customs import processes, is an instance of a complex socio-technical system with multiple stakeholders. In order to provide insight for policy analysis, we posit the appropriateness of agent-based modelling techniques for the simulation of potential anti-corruption policies in the maritime customs context. We outline the design of an agent-based simulation calibrated on the customs processes of an archetypal Mediterranean container port.

Categories and Subject Descriptors

K.4.3 [**Computers and Society**]: Organizational Impacts—*Reengineering*

General Terms

Design, Experimentation

Keywords

agent-based simulation; customs; policy analysis; ethics

1. INTRODUCTION

Research finds that customs corruption is not easily combated by policy changes, that reform policies can have unexpected side-effects, and that a broadly-based, systemic approach is required [9]. Our motivating domain is maritime customs, specifically the import of sea-based containers. We describe the design and implementation of a multiagent-based simulation (MABS) calibrated on evidence from ports in high-corruption Mediterranean countries.

Agent-based models and simulation have been used to study corruption. The closest to the current work is our earlier paper [4], which, in presenting a methodology for the selection of modelling paradigm, used the Port of Beirut, Lebanon, as a case study. In contrast to that purely conceptual work, we outline a designed, implemented, and validated simulation. However, we refer to Harb et al. [4] for background, additional motivation, and ethnography.

Over millennia the Mediterranean has been "a sea of corruption" [5]. Today, of the countries that border the Sea, the Balkan and Arab Mediterranean countries have high levels of perceived corruption, are mostly considered middle-income countries, and, in the case of the Arab countries, have low levels of political freedom [10]. We focussed on the ports in high-corruption countries that generally serve in the range of 750,000 to 1.5M TEUs per year (out of approximately 600M TEUs worldwide) with values greater than $200M. Our reason for considering an archetypal port of this size is because this is the size of terminal that begins to have a significant impact on the economics of the country in which it is situated. The Port of Beirut, for example, accounts for nearly 90% of Lebanon's customs income.

We undertook a data gathering phase in order to characterize the domain and the processes of interest, and to elicit structural, environmental, institutional, and behavioural knowledge necessary to build a MABS. Three information sources provide the basis for abstraction and modelling in MABS [2]: observation and data collection from the target system (i.e., the port), bibliographical review (i.e., theories), and domain experts. Chief among the found material were public reports and press articles on issues pertaining to practices at ports in our area of interest [3], and ethnography as reported by ourselves [11, 4] and others [1].

2. SIMULATION DESIGN

The most relevant artefacts in the customs import process are the owner's declaration, the bill of lading, the IM4 folder (described below), and the various customs orders and receipts. These are mostly self-explanatory, except for the IM4 folder. The IM4 consists of the invoice, packing list, various registration and identity verification documents, and the *Declaration of Value Elements* document. Often these documents are in electronic form.

Of the actors identified in the process, we included these:

Owner's agent (OA) Makes a decision what to declare based on the tariff for the actual contents of the container, the estimated cost of bribes necessary, and the estimated probability of inspection.

Freight forwarder (FF) Offers bribe to CO to expedite container if its due date is close. Will offer bribe for YELLOW or RED decisions if the expected cost of doing so is less than the cost of fines and fees; assumes that all COs will accept a bribe of sufficient amount (a warranted assumption when corruption is endemic). Expects to pay tips ('baksheesh') to CO and EO.

Customs Agency officer (CO) Unless opposed to bribes in principle, will accept any sufficient bribe, to expedite the container, wave inspection, or change decision outcome.

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Head of Customs (HCO) Supportive of the COs; does not overrule a CO's decision, except for RED decisions for a sufficient bribe. Will override assignment of container to a specific CO for a sufficient bribe.
Inspection officer (IO) Unless opposed to bribes in principle, will accept any sufficient bribe to either expedite the inspection or report a different contents than the actual found. Will work slowly unless given a baksheeh.
Excise officer (EO) Unless opposed to bribes in principle, will accept any bribe of sufficient amount, to set lower duty than the published tariff rules. Will work slowly on a container unless given a baksheeh.

We simplify the main customs processes as follows: (1) owner's agent submits IM4 to the freight forwarder company; (2) freight forwarder company assigns IM4 to a specific freight forwarder agent; (3) FF submits IM4 and other paper to customs agency via the *LIGHT* IT portal; (4) the customs agency's IT system assigns IM4 to a specific CO; (5) CO sees output of the *STAR* system and can override: the decision is RED (fines imposed, possibly seize container), YELLOW (inspect container), or GREEN (approve container, duty imposed); (6) if inspection is required, the IT system assigns a specific IO; (7) the IO inspects the container and sends the report to the CO; (8) the CO revises a YELLOW decision to RED or GREEN and informs the FF; (9) approved GREEN containers proceed to the Excise Department and are assigned by the IT system to a specific EO; (10) the EO computes the final duty, fines (if any), and other costs (handling, storage, etc.) and informs the FF; (11) the FF pays the due amount (plus interest, if applicable); and (12) the CO approves the release of the container. Note that the heads of the respective departments can override the IT system's assignment of officers, and they can also override the decisions of officers.

For the full implementation of the simulation, we used Jadex [8]. Each agent was represented as a Jadex 'BDIv3' agent. In addition to the 'public' documents in the IM4, agents have private information. For instance, the owner knows the true contents of the container, while the freight forwarder might not, and customs agents will not unless an inspection is ordered and is successful. The state of the container through the process is also recorded in its IM4.

3. EXPERIMENTS

We approximated the contents of container contents into ten categories giving a representative spread across attributes (small/large items, low/high value, perishable/not) and tariffs (exempt, standard, punitive) [7], and estimated the distribution of container contents from published statistics. Metrics included the direct cost of corruption, delays, average container turnaround time, tariffs collected and avoided, number of deviations from the published process, and the percentage of deviations detected. Results, to be reported in detail elsewhere, matched expected behaviour when baseline policy measures were applied, including tariff levels, fine levels, wage scale, chance of audit, and penalties on corrupt customs actors.

4. CONCLUSION

Overall, our observed results correlate with the literature that "localized punitive- or incentive-based policies cannot correct a situation of widespread corruption" [6]. We found that modifying existing process factors such as wage levels and fines had little effect in a situation of widespread corruption, that various measures could increase customs revenue but not reduce deviations—rather, bribe amounts simply increased—and that deviations could be reduced only by increasing inspections and audits, which either introduces delays or increases enforcement cost. Further, in practice in such a setting, the inspectors and auditors are themselves open to corruption.

Our work to date provides a testbed for exploring what-if policy changes and a mechanism for structuring out thinking on the impact of those changes, while also serving as a calibration stage for a more complex MABS, towards the ultimate goal of studying reform policies at multiple levels of the maritime customs socio-technical system. Future work is to expand the scope of simulation by, e.g., including additional actors, relaxing selected assumptions in the simulation design, and enhancing the agent negotiation behaviours.

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